Euphorbia esula

Classification

Phylum: Magnoliophyta
Class: Magnoliopsida
Subclass: Rosidae
Order: Euphorbiales
Family: Euphorbiaceae
Subfamily: Euphorbioideae
Tribe: Euphorbieae
Subtribe: Euphorbiinae
Genus: *Euphorbia*
Subgenus: *esula*
Section: *esula*
Subsection: *esulae*
Species: *Euphorbia esula* L.

General Life History

Leafy spurge is a long-lived herbaceous perennial plant (Best *et al*., 1980). Buds initiate elongation during the fall but remain below the soil surface throughout the winter (Messersmith *et al*., 1985). Bud elongation resumes in early spring and the above ground portions of the plant (shoots) become apparent in April or May, depending on location.

Vegetative shoots develop rapidly and reach their full height in June or July. Mature stem heights are variable, depending on soil and weather conditions, but generally range from 0.25 to 1.5 m. Stems may be branched or unbranched. Leafy spurge leaves are usually green or grayish-green in color, linear or lanceolate in shape, and from 2-8 cm long and 2-10 mm wide (Best *et al*., 1980). Leaves are arranged alternately along the stem. Leafy spurge possesses specialized, unisexual flowers in a compound umbellate arrangement (Selleck *et al*., 1962). On some shoots, flower buds begin to develop several weeks after the shoots first appear, with peak flowering occurring in June and July (Best *et al*., 1980). Flowers may also appear later during the growing season, depending on weather conditions (Raju, 1985).

Because of the sticky pollen, asynchrony in maturity of adjacent male and female flowers, and the presence of nectaries, leafy spurge appears to be pollinated primarily by insects (Best *et al*., 1980; Messersmith *et al*., 1985). Seeds develop and mature from July through September, and are then explosively expelled up to 5 m from the parent plant; generally, from 30-150 seeds are produced by each flowering shoot (Selleck *et al*., 1962). Leafy spurge seeds may be dispersed over longer distances by flowing water (Selleck *et al*., 1962), birds (Blockstein *et al*., 1987) or grazing mammals (Lacey *et al*., 1992). Spurge seeds are also transported by humans in gravel, soil, hay and farm equipment (Messersmith *et al*., 1985).

Leafy spurge seeds usually germinate in the early spring (Best *et al*, 1980). Though viability decreases over time, some dormant seeds may germinate after 10 or more years in the soil (Bowes and Thomas, 1978; Selleck *et al*., 1962). Typically, spurge seedlings develop a single shoot during the first growing season but do not flower (Messersmith *et al*., 1985). Seedling shoots are usually shorter and less robust than those originating from root buds, reaching heights of 20 cm or less. During the initial growing season, seedlings begin to develop an extensive root system that may extend up to about 1 m and that possesses many root buds (Messersmith *et al*., 1985). In general, seedlings serve to initiate new leafy spurge patches; exposed mineral soil associated with disturbance (e.g. cultivation, trails, roads, overgrazing) seem best suited for leafy spurge seedling and, hence, patch establishment (Belcher and Wilson, 1989). Only a small percentage of newly-germinated seedlings are able to survive in established patches (Best *et al*., 1980).

Established spurge patches possess a network of lateral and vertical roots that serve perenniating, reproductive, and nutrient and water storage functions (Stroh *et al*., 1990). Most of the root biomass is located in the upper 15 cm of the soil (Selleck *et al*., 1962), but some vertical roots may reach depths of 9 m or more (Best *et al*., 1980). Two types of adventitious buds are formed on the root system (Messersmith *et al*., 1985): crown buds are formed on the root crown, at the base of a current-year shoot, while root buds may form almost anywhere along the lateral and vertical roots. Generally, one or more crown buds will elongate at the same location each year, while the number and location of elongating root buds varies greatly from year to year and from plant to plant (Messersmith *et al*., 1985). Root buds may be formed “spontaneously” or in response to root injury (Messersmith *et al*., 1985). Most root buds occur near the soil surface, but some may be found more than 3 m deep along vertical roots (Stroh *et al*., 1990).

Only a subset of crown and root buds formed in a given year actually produce above ground shoots through a system of hormonal control and, perhaps, competition for water and nutrients (Raju, 1985). Removal of shoots (e.g. mowing or grazing) usually causes activation of some dormant crown and root buds, and the production of new shoots; new shoot density often exceeds that observed before the treatment (Messersmith *et al*., 1985). Leafy spurge root fragments as small as 2 cm long will produce new shoots and root systems and, hence, new plants, provided they remain buried in soil (Messersmith *et al*. 1985). Established leafy spurge plants expand vegetatively, through elongation of the horizontal roots and the formation of adventitious buds (Best *et al*., 1980). As some of these buds produce shoots in subsequent years, new root crowns are formed. The root connections among the new root crowns and the parent root system eventually disintegrate, resulting in independent, “daughter” plants. Through lateral expansion of the root systems, leafy spurge patches expand up to about 1 m in radius each year (Selleck *et al*., 1962, Stroh *et al*., 1990). At a given location, the rate of radial increase in patch size remains fairly constant from year to year (Selleck *et al*., 1962).

Pest Status

Leafy spurge occurs in at least 30 states and nine Canadian provinces (Dunn, 1979), but is a significant economic problem primarily in Minnesota, Montana, Nebraska, North Dakota, South Dakota, Wyoming, Alberta, Manitoba and Saskatchewan. Currently, about 660,000 ha are infested in Montana, North Dakota, South Dakota, and Wyoming, and the affected area doubles in size about every 10 years (Leitch *et al*., 1994).

Leafy spurge, like other members of the Euphorbiaceae, contains a milky latex throughout all parts of the plant. This latex is composed of a complex of chemicals, including a variety of terpenoid compounds (Mahlberg, 1989). Some latex chemicals from leafy spurge have skin irritant and tumor-inducing properties in mammals (Seip and Hecker, 1982; Upadhyay *et al*., 1978). Paradoxically, other compounds from *E. esula* latex may have antileukemic properties; plants in the family Euphorbiaceae have long been used to treat cancers and tumors in traditional medicine (Kupchan *et al*., 1975).

Due to its latex chemistry, leafy spurge can induce a variety of digestive maladies or, in sufficient quantities, may cause death when consumed by cattle (Kronberg *et al*., 1993). However, spurge is rarely eaten by cattle, who instead avoid spurge infested pastures despite the presence of palatable grasses (Hein and Miller, 1992; Lym and Kirby, 1987). Significant (>50%) reductions in forage utilization by cattle result when leafy spurge achieves 10% or more of plant cover (Hein and Miller, 1992). Interestingly, domestic sheep and goats are able to consume leafy spurge with no visible detrimental effects (Landgraf *et al*., 1984).

Leafy spurge is an aggressive competitor that, because of its expansive root system and dense shoot growth, is able to outcompete rangeland grasses and forbs for available water, nutrients, and light. In addition, leafy spurge appears to exert an allelopathic effect on other plants possibly through chemicals leached from decomposing leaf, stem, and root tissues from established leafy spurge patches Some species may disappear entirely from the spurge infested area. (Belcher and Wilson, 1989; Nowierski and Harvey, 1989). Leafy spurge infestations significantly reduce the abundance of native prairie plants (Belcher and Wilson, 1989). This reduction in native plant diversity may have a negative impact on wildlife populations (Wallace *et al*., 1992).

The primary economic impacts of leafy spurge are based on reductions in available forage and, hence, reduced cattle production on infested rangeland. In Montana, North Dakota, South Dakota, and Wyoming, Leitch *et al*. (1994) estimate that direct and secondary losses due to lost cattle production approach $120 million a year. Additional non-agricultural (e.g. recreational and watershed) losses (Wallace *et al*., 1992) bring the total losses due to leafy spurge to about $144 million annually in the four-state area (Leitch *et al*., 1994).